Amendments to the Claims:

1. (Cancelled)

2. (Currently Amended) A heterodyne interferometer according to Claim ~~1~~3, wherein the telescope comprises a transmitting telescope, and wherein the heterodyne interferometer further comprises a receiving telescope capable of receiving the reflected beam and thereafter directing the reflected beam to the detector.

3. (Currently Amended) A heterodyne interferometer ~~according to Claim 1 further~~ comprising:

an acoustic-optical modulator (AOM) capable of receiving an optical source signal and an electrical radio frequency (RF) signal, superimposing the RF signal on the source signal, and thereafter outputting a zero order, un-modulated optical beam and a higher order, modulated optical beam, wherein one of the zero order and higher order beams comprises a target beam and the other beam comprises a local oscillator beam;

a telescope capable of receiving the target beam, and thereafter directing the target beam through a beam propagation medium to a target such that at least a portion of the target beam can reflect off of the target;

a beam splitter capable of receiving the local oscillator beam and the reflected beam from the target, wherein the beam splitter is capable of coherently combining the local oscillator beam and the reflected beam to produce a fringe pattern;

a detector capable of detecting the fringe pattern to thereby generate an electrical beat signal to permit the beat signal to be subsequently demodulated based upon the RF signal to thereby determine an electrical signal proportional to a phase difference between the reflected beam and the local oscillator beam, wherein the phase difference can represent an optical path difference between the beam splitter and the target;

a half-wave plate capable of receiving the target beam from the AOM and rotating the plane of polarization of the target beam;

a polarizing beam splitter capable of receiving the target beam from the half-wave plate, and thereafter dividing the target beam into a horizontally-polarized target beam and a vertically-polarized target beam; and

a quarter-wave plate capable of receiving the vertically-polarized target beam, circularly-polarizing the target beam, and thereafter passing the circularly-polarized target beam to the telescope, wherein the circularly-polarized target beam becomes circularly-polarized in an opposite direction when the target beam reflects off the target,

wherein the quarter-wave plate is also capable of receiving the reflected beam and rotating the plane of polarization of the reflected beam ninety degrees compared to the polarization of the beam passed to the telescope, and wherein the polarizing beam splitter is capable of receiving the reflected beam from the quarter-wave plate and thereafter reflecting the reflected beam to the ~~detector~~ beam splitter as a non-polarized reflected beam.

4. (Currently Amended) A heterodyne interferometer according to Claim ~~1~~ 3 further comprising:

a signal source capable of providing the source signal, wherein the source signal has a coherence length at least as long as a round trip distance between the telescope and the target.

5. (Currently Amended) A heterodyne interferometer according to Claim ~~1~~3, wherein the beam splitter is capable of coherently combining the local oscillator beam and the reflected beam such that the detector is capable of having a minimum detectable power above a power of the reflected beam.

6. (Currently Amended) An adaptive optics system comprising:

an adaptive optics assembly comprising a deformable mirror comprising at least one actuator capable of driving a shape of the deformable mirror, wherein the at least one actuator is capable of driving the shape of the deformable mirror; and

a heterodyne interferometer capable of providing at least one electrical signal to the adaptive optics assembly to thereby drive the shape of the deformable mirror, wherein the heterodyne interferometer comprises:

a transmitter assembly capable of superimposing an electrical radio frequency (RF) signal on a source signal, and thereafter outputting a zero order, un-modulated optical beam and a higher order, modulated optical beam, wherein one of the zero order and higher order beams comprises a target beam and the other beam comprises a local oscillator beam, and wherein the transmitter assembly is capable of passing the target beam to a telescope capable of directing the target beam through the beam propagation medium to a target such that at least a portion of the ~~received~~ target beam can reflect off of the target and the deformable mirror; and

a receiver assembly capable of receiving the local oscillator beam and the reflected beam from the deformable mirror, coherently combining the local oscillator beam and the reflected beam to produce a fringe pattern, wherein the receiver assembly is capable of generating an electrical beat signal based upon the fringe pattern, and demodulating the beat signal based upon the RF signal to thereby determine an electrical signal proportional to a phase difference between the reflected beam and the local oscillator beam, wherein the phase difference can represent an optical path difference between the heterodyne interferometer and the target.

7. (Original) An adaptive optics system according to Claim 6, wherein the transmitter assembly comprises:

a signal source capable of providing the source signal, wherein the source signal has a coherence length at least as long as a round trip distance between the telescope and the target; and

an acoustic-optical modulator (AOM) capable of receiving an optical source signal and the RF signal, superimposing the RF signal on the source signal, and thereafter outputting a zero order, un-modulated optical beam and a higher order, modulated optical beam.

8. (Original) An adaptive optics system according to Claim 6, wherein the receiver assembly comprises:

a beam splitter capable of receiving the local oscillator beam and the reflected beam from the deformable mirror, wherein the beam splitter is capable of coherently combining the local oscillator beam and the reflected beam to produce a fringe pattern; and

at least one detector capable of detecting the fringe pattern to thereby generate at least one electrical beat signal such that the at least one beat signal can be subsequently demodulated based upon the RF signals to thereby determine at least one electrical signal proportional to a phase difference between the reflected beam and the local oscillator beam, wherein the phase difference can represent an optical path difference between the beam splitter and the target.

9. (Original) An adaptive optics system according to Claim 8, wherein the beam splitter is capable of coherently combining the local oscillator beam and the reflected beam such that the detector is capable of having a minimum detectable power above a power of the reflected beam.

10. (Original) An adaptive optics system according to Claim 6, wherein the telescope comprises a transmitting telescope, and wherein the system further comprises a receiving telescope capable of receiving the reflected beam and thereafter directing the reflected beam to the deformable mirror such that the deformable mirror can pass the reflected beam to at least one detector.

11. (Original) An adaptive optics system according to Claim 6 further comprising:

a half-wave plate capable of receiving the target beam from the transmitter assembly and rotating the plane of polarization of the target beam;

a polarizing beam splitter capable of receiving the target beam from the half-wave plate, and thereafter dividing the target beam into a horizontally-polarized target beam and a vertically-polarized target beam; and

a quarter-wave plate capable of receiving the vertically-polarized target beam, circularly-polarizing the target beam, and thereafter passing the circularly-polarized target beam to the telescope,

wherein the quarter-wave plate is also capable of receiving the reflected beam from the deformable mirror and circularly-polarizing the reflected beam such that the reflected beam has a ninety degree phase shift compared to the circularly-polarized target beam to thereby produce a horizontally-polarized reflected beam, and wherein the polarizing beam splitter is capable of receiving the horizontally-polarized reflected beam from the quarter-wave plate and thereafter reflecting the horizontally-polarized reflected beam to the detector.

12. (Currently Amended) A method of measuring at least one of movement of a target and variances in a beam propagation medium, the method comprising:

receiving an optical source signal and an electrical radio frequency (RF) signal, superimposing the RF signal on the source signal, and thereafter outputting a zero order, un-modulated optical beam and a higher order, modulated optical beam, wherein one of the zero order and higher order beams comprises a target beam and the other beam comprises a local oscillator beam;

receiving the target beam at a half-wave plate and rotating the plane of polarization of the target beam;

receiving the target beam from the half-wave plate, and thereafter dividing the target beam into a horizontally-polarized target beam and a vertically-polarized target beam;

receiving the vertically-polarized target beam at a quarter-wave plate, circularly-polarizing the target beam, and thereafter passing the circularly-polarized target beam to a telescope;

directing the circularly-polarized target beam, via ~~a heterodyne interferometer~~the telescope, through the beam propagation medium to a target such that at least a portion of the ~~received~~ target beam can reflect off of the target, wherein the circularly-polarized target beam becomes circularly-polarized in an opposite direction when the target beam reflects off the target;

receiving the reflected beam at the quarter-wave plate and rotating the plane of polarization of the reflected beam ninety degrees compared to the polarization of the beam passed to the telescope;

receiving the reflected beam from the quarter-wave plate and thereafter reflecting the reflected beam to a beam splitter as a non-polarized reflected beam;

receiving the local oscillator beam and the non-polarized reflected beam~~ from the target~~ at the beam splitter, and thereafter coherently combining the local oscillator beam and the non-polarized reflected beam to produce a fringe pattern; and

detecting the fringe pattern to thereby generate an electrical beat signal such that the beat signal can be subsequently demodulated based upon the RF signal to thereby determine an electrical signal proportional to a phase difference between the reflected beam and the local oscillator beam, wherein the phase difference provides a measure of an optical path difference between the heterodyne interferometer and the target.

13. (Currently Amended) A method according to Claim 12~~, wherein directing the target beam comprises directing, via a telescope of the heterodyne interferometer, the target beam, and wherein the method~~ further ~~comprises~~comprising:

providing the source signal, wherein the source signal has a coherence length at least as long as a round trip distance between the telescope and the target.

14. (Original) A method according to Claim 12, wherein detecting the fringe pattern comprises detecting, via a detector, the fringe pattern, and wherein coherently combining the local oscillator beam and the reflected beam comprises coherently combining the local oscillator beam and the reflected beam such that the detector is capable of having a minimum detectable power above a power of the reflected beam.

15. (Currently Amended) A method of controlling an adaptive optics assembly comprising a deformable mirror including at least one actuator for driving the shape of the deformable mirror, the method comprising:

measuring at least one of movement of a target and variances in a beam propagation medium, wherein measuring at least one of movement of a target and variances in a beam propagation medium comprises:

superimposing an electrical radio frequency (RF) signal on a source signal, and thereafter outputting a zero order, un-modulated optical beam and a higher order, modulated optical beam, wherein one of the zero order and higher order beams comprises a target beam and the other beam comprises a local oscillator beam;

directing the target beam, via a heterodyne interferometer, through the beam propagation medium to a target such that at least a portion of the ~~received~~ target beam can reflect off of the target and the deformable mirror;

receiving the local oscillator beam and the reflected beam from the deformable mirror, and thereafter coherently combining the local oscillator beam and the reflected beam to produce a fringe pattern; and

generating an electrical beat signal based upon the fringe pattern, and thereafter demodulating the beat signal based upon the RF signal to thereby determine an electrical signal proportional to a phase difference between the reflected beam and the local oscillator beam, wherein the phase difference provides a measure of an optical path difference between the heterodyne interferometer and the target; and

providing at least one electrical signal to the at least one actuator to thereby drive the shape of the deformable mirror.

16. (Original) A method according to Claim 15, wherein directing the target beam comprises directing, via a telescope of the heterodyne interferometer, the target beam, and wherein measuring at least one of movement of a target and variances in a beam propagation medium further comprises providing the source signal, wherein the source signal has a coherence length at least as long as a round trip distance between the telescope and the target.

17. (Original) A method according to Claim 15, wherein generating an electrical beat signal comprises detecting the fringe pattern to thereby generate the electrical beat signal.

18. (Original) A method according to Claim 15, wherein detecting the fringe pattern comprises detecting, via a detector, the fringe pattern, and wherein coherently combining the local oscillator beam and the reflected beam comprises coherently combining the local oscillator beam and the reflected beam such that the detector is capable of having a minimum detectable power above a power of the reflected beam.